BEHAVIORAL EATING PATTERNS: UNDERSTANDING THE RELATIONAL DYNAMICS OF NEUROTICISM AND IMPULSIVITY

An Undergraduate Research Scholars Thesis

by

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ABSTRACT

Behavioral Eating Patterns: Understanding the Relational Dynamics of Neuroticism and Impulsivity. (May 2014)

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Disordered eating affects approximately 24 million people in the United States with 95% of the cases falling between the ages of 12 and 25 (The Renfrew Center Foundation for Eating Disorders, 2003; ANAD, 2013). Approximately 90% of female, college students endorse attempting to control their weight through dieting, with 25% reporting the use of binging and purging as a weight management technique (Shisslak, Crago & Estes, 1995). Research has linked high neuroticism and impulsivity to cyclic patterns of weight change. However, the exact mechanism though which neuroticism and impulsivity affect disordered eating remains unknown. To understand the effects of personality and behavioral traits on eating patterns in this vulnerable developmental age cohort, the present study aimed to investigate the role of neuroticism and behavioral impulsivity in predicting engagement in disordered eating. Adolescents and emerging adults were presented with surveys and behavioral tasks measuring eating attitudes, and personality, and impulsivity. Results showed that neurotic groups (i.e., low, moderate and high) differed in disordered eating engagement and in delay discounting, but not disinhibition or inattention. In addition both neuroticism and delay discounting were significantly associated with patterns of disordered eating. However, delay discounting appeared to mediate the relationship between neuroticism and disordered eating. These results should guide prospective research to explore the relations between neurotic and impulsive behavior,

particularly delayed discounting on disordered eating that will assist in education-, prevention-, and treatment efforts targeting at the development of maladaptive eating behaviors.

DEDICATION

To my family and friends for their unwavering love and support forever and always.

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CHAPTER I

INTRODUCTION

The incidence of eating disorders, and more broadly disordered eating, has been growing at an unprecedented rate. Disordered eating affects approximately 24 million people in the U.S. with most individuals indicating the onset to have occurred between the ages of 12 and 13, with almost all cases beginning by age 20 (The Renfrew Center Foundation for Eating Disorders, 2003; NEDA, 2014). Adolescence and emerging adulthood represent a critical time in the manifestation and maintenance of disordered eating, as 95% of eating disorder cases occur between the ages of 13 and 26. More than half of all adolescent females and a third of adolescent males endorse engaging in unhealthy weight control behaviors such as skipping meals, fasting, smoking cigarettes, vomiting, and taking laxatives (Neumark-Sztainer, 2005). Sadly, Anorexia is the third most common chronic illness among adolescents (Public Health Services Office in Women's Health, 2000). When transitioning to emerging adulthood, women appear to be more vulnerable -- with 91% reporting engagement in disordered eating or unhealthy "dieting," with a fourth engaging in binging and purging as weight management techniques (Shisslak et. al., 1995; The Renfrew Center Foundation for Eating Disorders, 2003). However, it is male adolescents and emerging adults who are least likely to seek treatment when engaging in disordered eating, even though they comprise 10-15% of those individuals experiencing clinical anorexia or bulimia (Carlat & Camargo, 1997; American Psychological Association, 2001).

Unfortunately, disordered eating is often a precursor to Eating Disorders (EDs). Roughly 35% of "normal dieters" will progress to pathological dieting and 20-25% progressing to partial or full

syndrome disorders (Shisslak, et. al, 1995). The Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5) classifies three types of eating disorders: Anorexia Nervosa, Bulimia Nervosa, and Binge-Eating Disorder (Butcher et al, 2013). Each of these three disorders is broken down by the symptomology the individual presents and includes such criteria as: fear to maintain a normal body weight for age and height as in anorexia, episodes of binge eating followed by an inappropriate compensatory behavior to prevent any weight gain as in bulimia, and recurrent episodes of drastic loss of control in food consumption as in binge-eating disorder (Butcher et al, 2013). One tenth of individuals will seek treatment for eating disorders or disordered eating, and only 35% of those individuals seeking treatment will receive this treatment as a specialized facility (Noordenbox, 2002).

Disordered eating, specifically, is defined as eating in a way that has the potential to be physically and psychologically damaging, and includes such behaviors as using laxatives, binging/purging, compulsive exercising, intense fears of gaining weight and having an altered self-image (Butcher, Mineka & Hooley, 2013). Adolescents and emerging adults engaging in disordered eating can experience depression, suicidality, low-self-esteem, poor emotional well-being, mood swings, substance abuse, and a withdrawal from interpersonal relationships (Eating Disorders Victoria, 2012; NIMH, 2013; Croll, Neurmark-Sztainer, Story & Ireland, 2002). Physically, they are placing themselves at risk for depression, cardio-vascular risk, decreased bone-density, fatigue, electrolyte and hormonal imbalance, gastric ruptures, poor dental hygiene, high blood pressure, high cholesterol, heart disease, and death (NEDA, 2014). It is important to note that eating disorders have the highest mortality rate of any mental illness, with anorexic-related eating behavior being associated with a mortality rate 12 times higher than the death rate

associated with all cases of death for females ages 15-24 years (Sullivan, 1995). By contrast, ordered or healthy eating is characterized by a distribution of energy over the course of the day, as well as three meals and one to three small snacks. Ordered eating has been shown to improve health, nutrition, and healthy weight range (Berg, Lappas, Wolk, Strandhagen, Toren, Rosengren, Thelle & Lissner, 2009) by preventing weight gains, promoting weight loss, and relieving symptoms of depression, anxiety, and negative mood (U.S. Department of Health and Human Services, 2008).

Adolescents and emerging adults participating in disordered eating patterns were more likely to report difficulties and insecurities of responsibilities of adulthood as well as feeling out of control of their life (McIvor, 2002). Controversial online sites, such as "pro-Ana/pro-Mia" intended to prevent and treat EDs and disordered eating, have turned into avenues of attaining "thinspiration" images, or images inspiring weight loss, and information on potentially unhealthy behaviors, particularly among college students (Davis, 2010). Research has revealed that 47% of adolescent girls had a desire to lose weight because of magazine pictures, while 70% reported that media images influenced their idea of a perfect body shape (ANAD, 2014).

Although groups of friends, living conditions, and life roles often change during late adolescence and early emerging adulthood, peer-dieting exposure in college populations was a predictor of disordered eating in women during emerging and early adulthood (Keel, Forney, Brown & Heatherton, 2013). Interestingly however, having a roommate who practiced dieting behaviors in college increased disordered eating behaviors while cohabiting, but decreased the drive for thinness and ED symptoms in later life. Differences in disordered eating patterns have emerged

among various ethnic groups. Caucasian, college women were most likely to practice restraint and disordered eating patterns throughout the college years, whereas populations, such as the African-American population, were less likely to show disordered patterns of eating while in college (Stojek & Fischer, 2013).

With the highest rate of mortality among all mental disorders, research focused on the treatment, and especially the prevention of eating disorders is greatly needed. However, in 2011, the average amount spent on research was only $0.93 per individual diagnosed with an ED (National Institute of Health, 2011). Further, the examination of disordered eating as a precursor to EDs, its development, and associated risks during adolescence and emerging adulthood is scarce. Thus, recent research efforts have focused on determining the risk factors associated with disordered eating broadly, to identify those at risk for eating disorders. Multiple etiologies focusing on biological, socio-cultural, and behavioral factors have been proposed with hopes of enhancing prevention, education, and treatment programs. As a result, it has been proposed that certain personality-behavioral traits play a significant role in the pathogenesis and development of disordered eating, which renders certain emerging adults more vulnerable to disordered eating-conducive environments (e.g., college) than others.

A large majority of research has focused on personality characteristics. Specifically, neuroticism, which is marked by high levels of anxiety and perfectionism, is one of the most consistent associated risk factors in research studying disordered eating (Butcher et al, 2013). Individuals with EDs have been found to have higher levels of neuroticism than the general population, as well as those engaging in behaviors on the ED spectrum (Cassin & Von Ranson,

2005; Davis & Fischer, 2013; Izydorczyk, 2012; Maclaren & Best, 2009). Interestingly, emotional eating, a facet of disordered eating, was also found to be related to both binge eating and neuroticism (Izydorczyk, 2012).

A study on the relationship between neuroticism and disordered eating attitudes found that individuals who scored lower on the neuroticism scale were predicted to have less disordered eating behaviors and attitudes than those with higher levels of neuroticism (Grella, 2013). Neuroticism was also shown to mediate the relationship between genetic predispositions and disordered eating behaviors (DEBs). In both monozygotic and dizygotic twins, rates of neurotic personality were strong predictors in likelihood of developing particular eating behaviors. Increased neuroticism correlated with higher rates of disordered eating patterns (Ferguson, Munoz & Winegard, 2012). Moreover, the negative affect experienced by neurotic individuals was found to moderate the relationship between body dissatisfaction and disordered eating. Levels of anxiety, both being components of neuroticism, have been shown to increase the likelihood of developing disordered eating patterns (Juarascio, Perone & Timko, 2011), meaning that higher levels of neuroticism forecasted higher levels of disordered eating at a proportional rate (Brannon & Petrie, 2008). This supports previous findings that disordered eating may serve as a coping mechanism for neuroticism.

However, previous results linking neuroticism to disordered eating are not consistent. A study done by Hollin, Houston, and Kent (1985) found that females not diagnosed with an ED, but who were found to have high levels of neuroticism, were more concerned about eating than those who were average on the neuroticism scale. These individuals were also more familiar with

available information on dieting and increased their dieting habits, but showed no difference in weight from those that scored low to average on neuroticism. This suggests that neuroticism alone does not predict disordered eating patterns, but rather a preoccupation with food and weight that may not manifest into maladaptive behaviors. Brown (2007) found that neuroticism did not appear to be significant personality characteristic in prediction of internalization of the thin-ideal or body dissatisfaction, and therefore eating disorder development. Further links between neuroticism and disordered eating, as well as research pertaining to a linkage between neuroticism and obesity, are currently absent from the literature. Thus, understanding the underlying behavioral mechanisms influencing disordered eating choices, such as diet and exercise, have recently become of interest. At the forefront of this discussion has emerged the contribution of impulsivity to disordered eating.

Impulsivity, behavior characterized by little forethought, unplanned reactions without considering future consequences, and disregard for choices in favor of long-term success (International Society for Research on Impulsivity, 2011), is considered a dimensional construct. These constructs in adolescents and emerging adults are thought to include: failure to maintain attention for a period of time, inhibition of responses, and inability to see the long-term consequences and failure to make decisions in favor of long-term goals (Reynolds, Penfold & Patak, 2008).

Within the spectrum of eating disorders, impulsivity has been extensively studied (Claes, Vandereycken & Vertommen, 2005; Claes, Nederkoom, Vandereycken, Guerrieri & Vertommen, 2006; Fischer, Smith & Cyder, 2008). Generally, those women with greater body

dissatisfaction were found to be more impulsive, such as those that fall on either extreme of the eating disorder spectrum (Scherr, Ferraro, & Weatherly, 2010). Further, particular ED subtypes were determined by rates of impulsivity, with bingeing/vomiting types showing the highest correlations of urgency and sensation seeking behaviors (Claes et. al., 2005). Fields, Sabet, Peal, and Reynolds (2011) found that impulsivity contributes to onset and maintaining of behaviors leading to obesity as well as being more prevalent in obese emerging adults when compared to healthy-weight counterparts. Within a sample of male, college students, results showed individuals with a higher occurrence of impulsivity were at risk for the development of an eating disorder (Feltman & Ferraro, 2011).

As discussed, the majority of studies presented support the assertion that impulsivity is associated with disordered eating and increased levels of impulsivity are associated with greater disordered eating. However, a few studies have found no such effect. For example, Juarascio, Perone, and Timko (2011) found that impulsivity did not moderate the relationship between body dissatisfaction and disordered eating. Another suggested that impulsivity plays a small role in weight status in adolescents, but the effect may be limited by other factors, such the role parents play in the adolescents' feeding behavior. Additional research examined the role food plays in impulsiveness. Results indicated overweight and obese children were only more impulsive, compared to their normal weigh counterparts, when the condition was food; there was no impulsivity difference in non-food conditions (Thamotharan, Lange, Zale, Huffhines & Fields, 2013).

Recent research has begun to explore the interplay between neuroticism and impulsivity on disordered eating and ED individuals. Neuroticism has also been considered to be a factor constituting an impulsive personality (Eysenck & Eysenck, 1968). Individuals with high levels of neuroticism, or negative affect state, were more likely to act irrationally, or make rash decisions, thereby making these individuals more vulnerable to disordered eating (Davis & Fischer, 2013). Bulimic women were found to have higher rates of distress as a result of their neurotic personality trait and in response, greater levels of impulsivity, than women who were not diagnosed with an eating disorder (Fischer, Smith, Annus & Hendricks, 2007). It was also determined that binge eating, a common type of disordered eating, was found to help bulimic women cope with both their neurotic tendencies and impulsive urges, suggesting that disordered eating may serve as a coping mechanism and a result of both neurotic and impulsive tendencies (Fischer et al., 2007). Studies pertaining to the interplay between those with anorexia, neuroticism, and impulsivity are scare; research into the linkage between these three variables and their causes is needed in the ED/disordered eating field of study.

Previous research examining the association between neuroticism and disordered eating are mixed. Further research examining impulsivity and disordered eating, as well as neuroticism, impulsivity and disordered eating is scarce and no study to date has examined impulsivity as a mediator between neuroticism and disordered eating. Moreover, previous research has almost exclusively focused on adult populations and not adolescents and emerging adults; even though this developmental period is most vulnerable to the onset of disordered eating. An examination of neuroticism and impulsivity in the manifestation and maintenance of disordered eating is needed. Neuroticism renders individuals susceptible to more stress, which may result in the use

of unhealthy coping mechanisms, such as disordered eating. Understanding how impulsivity, as a behavioral construct, may mediate the relationship between neuroticism and disordered eating can provide a better understanding of the underlying mechanism through which these factors relate to one another.

The present study aims to expand on prior research by focusing on adolescents and emerging adults who have not been diagnosed with an ED, but may be engaging in disordered eating at sub-threshold levels. The objective for the present study is two-fold: (1) to investigate the relationships between levels of neuroticism and impulsivity with disordered eating and (2) to determine if impulsivity mediates the relationship between neuroticism and engagement in disordered eating. This information may increase our knowledge of the underlying mechanisms contributing to the onset of disordered eating and therefore eating disorders, in adolescents and emerging adults in hopes to assist future education-, prevention-, and treatment efforts.

CHAPTER II

METHODS

Participants

Participants included adolescents and emerging adults between the ages of 13 and 19 ($N = 40$) recruited from the community and undergraduate psychology courses. More than half of the participants were female ($n = 25$; 62.5%) and the average age of all participants was 18.28 years (*S.D.* = 1.32). The vast majority of participants reported Euro-American ethnicity ($n = 30$; 75.0%), while other reported Asian ($n = 1$; 2.5%), Hispanic ($n = 8$; 20.0%), and Other ($n = 1$, 2.5%) ethnicity. All participants included in the present analyses received either (1) monetary compensation between $25-35, with specific amount earned dependent on task performance ($n = 6$) or (2) course credit for their participation ($n = 34$). Demographics information for these participants are listed in Table 1.

Exclusion Criteria

Potential participants were excluded if they were currently (a) taking ADHD medication, (b) engaged in a weight management program and (c) not proficient in English. These exclusion criteria were necessary because the (a) stimulant medications used in the treatment of ADHD have been shown to reduce impulsive behavior on the behavioral measures included in this study (e.g., Tannock et al., 1989), (b) the nature of weight management programs is to train individuals to inhibit impulsive behaviors, (c) consenting, instructions and assessment measures will be provided in English only. Individuals with a diagnosis of ADHD who were not currently taking medication were allowed to participate.

Procedure

All potential participants, and parent/legal guardian (if necessary) were invited to the research laboratory where they were a research assistant informed them of their rights. Participants who chose to take part in the study provided written consent, which was previously approved by the Institutional Review Board. Initial weight status verification will be determined by self-report. Once participants arrive in the laboratory, they will be weighed and their height will be measured using a Seca 763 digital scale with digital height rod. BMI will be calculated for age and sex based on the most recent Centers for Disease Control and Prevention, National Center for Health-Statistics growth curves (CDC, 2000).

Adolescents completed a short demographic questionnaire specifically designed for this study as well as self-report measures of disordered eating (Eating Disorder Examination Questionnaire) and neuroticism (Eysenck Personality Questionnaire). Next, participants completed the three behavioral tasks (Delay Discounting Questionnaire, Go/Stop, and Continuous Performance Test) described in the measures section. Any delayed money earned with the delay-discounting task (e.g., to be received in days or weeks) was honored by mailing the amount of money to the participant at the time of the specified delay**.** Before completing each task, participants received standard instructions and practiced each procedure. Total time for completing the study was 150 minutes and task order was randomized.

Measures

Behavioral measures of impulsivity

Delay Discounting Questionnaire. Delay discounting is often considered an index of impulsive behavior. Impulsive individuals are thought to be highly insensitive to delayed consequences (rewards or punishers) and therefore exhibit greater preference for more immediate outcomes (Ainslie, 1975; Hernstein, 1981; Logue, 1988; Rachlin & Green, 1972). Generally speaking, delayed consequences influence behavior less than more immediate consequences; however, for highly impulsive individuals this tendency is pronounced. As a result, such individuals show a stronger preference for immediate, smaller rewards *at the expense of* larger, more valuable delayed rewards. The assessment of delay discounting to be used for this research (Richards et al., 1999) presents participants with choices between $10 available after a specified delay (1,2,30, 180, or 365 days) and a smaller amount available immediately (e.g, 'would you rather have $10 in 30 days or $2 now?'). This computerized task uses an adjusting amount procedure to derive indifference values between the delayed standard and immediate adjusting options for each of the five delays assessed. An indifference point value reflects the smallest amount of money an individual chooses to receive immediately instead of the standard delayed amount ($10) at the specified delay. Smaller indifference values, calculated using discounting curves and analyzed with an area under the curve (AUC) method, signify greater discounting by delay and greater impulsivity. Higher rates of delay discounting (i.e. smaller indifference values) are often associated with addiction (see Reynolds 2006, for a review) and indicate that a person is behaviorally under-controlled by temporally distant events.

Go/Stop-Task. Impulsivity also has been defined as a lack of inhibitory control (disinhibition;

Barkley, 1997). The Go/Stop Task (Dougherty et al., 2003) was designed to measure behavioral inhibition. For this task, participants are presented a series of three digit numbers (e.g., **231)** on a computer screen, with a 1s blank screen separating each three digit number. Participants complete 240 trials (2 blocks of 120 three digit numbers) in which they are instructed to respond as quickly as possible by left clicking the mouse button when a matching three digit number appears (go signal). On a randomly selected 25% of the trials, the numbers turn from black to red, and participants are instructed that when the numbers turn red, they are to inhibit their responses. The length of time between the presentation of the black numbers and the numbers turning red varies from trial to trial. Individual differences in inhibitory control are inferred from the average time interval between black and red stimuli that a participant can successfully stop 50% of the time. Participants who are able to stop 50% of the time with shorter intervals are considered to have better inhibitory control. Each participant's best estimate of reaction time, or stop latency, for the session closest to the 50% during the second block of trials is recorded. Numerous studies have shown that participants with ADHD are less able to inhibit responses on this type of measure than non-ADHD control participants (e.g., Tannock et al., 1989).

Continuous-Performance-Task II (CPT II). The CPT II (Connors, 2004) is a computerized measure of sustained attention, or vigilance, and is often used as a diagnostic tool for ADHD. Participants are presented a computer screen with white letters flashing on a black background. Participants are instructed to respond as quickly as possible by left clicking the mouse button when they are presented letters on the computer screen other than the letter "X". Letters are presented at variable rates of 1, 2, or 4 s. The CPT II requires ~14 minutes to complete. The primary dependent measures involve response accuracy (errors of omission and commission).

Errors of omission occur when there is no response to a letter other than "X," which is taken to reflect inattention. Commission errors occur when there are responses to the letter "X." In combination with fast reaction times, commission errors reflect impulsivity (behavioral disinhibition). This aspect of the CPT II may be similar to the Stop RTs of the Go/Stop Task, thus potentially providing a second assessment of behavioral disinhibition. Very little addiction research has been reported for the CPT II, though one recent study demonstrated that adolescents who smoke make significantly more numbers of omissions than those who do not smoke (Fields et al., 2009).

Eating Disorder Examination (EDE). The EDE (Fairburn, Cooper, & O'Connor, 2008) is the most frequently used clinical interview for eating disorders. The EDE takes between 45 – 75 minutes to complete and can be scored to yield four eating disorder diagnoses, Anorexia Nervosa, Bulimia Nervosa, Binge Eating Disorder, and Eating Disorder NOS. In addition, there are four subscale scores on eating disorder psychopathology, consisting of Eating Concern (preoccupation with food and eating, fear of loosing control, eating in secret), Shape Concern (obsessing over having a flat stomach, fear of gaining weight and altering shape, dissatisfaction/discomfort with shape), Weight Concern (dissatisfaction with weight or desire to lose weight), and Dietary Restraint (restraint/avoidance of eating, dietary rules, continually having an empty stomach).

Short Form of the Eysenck Personality Questionnaire (EPQR-S). The EPQR-S (Eysenck & Eysenck, 1992) is a widely used 48-item self-report questionnaire used to measure personality characteristics, primarily extroversion vs. introversion and levels of neuroticism. All items are

"yes" or "no" responses and indicate the degree to which the respondent is predisposed to experience the measured personality characteristic. For the purpose of the present study, only questions pertaining to neuroticism were scored. Higher scores reflect greater levels of neurotic behavior. The scores of the participants were divided into three groups: scores 9 or above were considered to be in the "high" group, scores between four and eight were considered moderate, and scores below four were low on neuroticism.

Statistical Analysis

One-way analysis of variance (ANOVA) was used to quantify the influence of neuroticism. Differences in disordered eating engagement and impulsivity between neurotic groups were determined. To test the simple effects between groups, Tukey's post-hoc analyses were conducted at the $\alpha = 0.05$ significance level.

Mediation analyses were conducted according to the format as outlined in Hamilton, Ansell, Potenza, and Sinha (2013). Regressions conducted within the mediation model included neuroticism, impulsivity and disordered eating. To test the proposed mediation model (*Figure 1*), ordered regressions were used to test a, b, c and c′ pathways. The "a' pathway represented non-standardized beta values from the linear regressions of neuroticism on the proposed mediator or impulsivity (Hamilton et al., 2013). The "b" pathway represented the regression of the mediator, impulsivity, on the dependent variable, disordered eating. The "c" pathway represents the linear regression of the neuroticism score on disordered eating without impulsivity in the model. The "c′" pathway represents the linear regression of neuroticism on disordered eating behavior with the effects of impulsivity controlled. The "c′" pathway is also called the direct effect of

neuroticism on disordered eating as it represents the effects of neuroticism on disordered eating independent of impulsivity. Models were run for neuroticism with impulsivity as the mediating variables, overall disordered eating as the dependent variable, and gender as a covariate. This variable was chosen as a covariate because it was positively associated with engagement in disordered eating. Mediation was determined to occur if the effect of the c pathway decreased in the c′ pathway (Hamilton et al., 2013). If the effect was reduced but still significant partial mediation was determined by conducting a Sobel's test of medication to show if the reduction was statistically significant.

CHAPTER III

RESULTS

Differences in Disordered Eating by Neuroticism

A 3 x 5 (neurotic group x weight/eating behavior) split plot ANOVA was used to compare disordered eating among the three neurotic groups (i.e., low, medium and high) (*refer to table 2)*. Results revealed significant ($p < 0.05$) group differences with regard to eating concern ($F_{(2,39)} = 3.737$, $p = 0.033$), shape concern ($F_{(2,39)} = 15.247$, $p < 0.001$), weight concern ($F_{(2,39)} = 9.723$, $p < 0.001$), and overall disordered eating patterns ($F_{(2, 39)} = 9.345$, $p < 0.001$). Eating restraint did not yield significance ($F_{(2,39)} = 2.045$, $p = 0.144$). Tukey's post hoc analysis revealed significant differences. Within eating concern, highly neurotic individuals showed significantly more concern than low neurotic individuals ($p = 0.032$; $p < 0.001$; $p < 0.001$; $p < 0.001$) and moderate neurotic individuals ($p = 0.052$; $p = 0.027$; $p = 0.010$; $p = 0.013$) with regard to eating concern, shape concern, weight concern, and global disordered eating respectively. Additionally, moderate neurotic individuals showed more shape concern compared to low neurotic individuals ($p = 0.007$).

Differences in Impulsivity by Neuroticism

A second 3 x 3 (neurotic group x impulsivity) split pilot ANOVA was used to compare impulsivity among the low, moderate, and highly neurotic groups (*refer to table 3)*. Results indicated significant ($p < 0.05$) group differences on delay discounting (DDQ; $F_{(2,38)} = 4.254$, $p = 0.022$). However, no significant group differences emerged among groups with regard to performance on the Go/Stop ($F_{(2,26)} = 0.266$, $p = 0.769$), CPT commissions ($F_{(2,39)} = 1.580$, $p =$

0.220), and CPT omissions ($F_{(2,39)} = 0.279$, $p = 0.758$). Tukey's post hoc tests revealed that highly neurotic individuals discounted delayed monetary rewards more so than low neurotic individuals ($p = 0.017$).

Mediation Analysis

Due to non-significant results among groups for performance on the Go/Stop Task as well as the CPT (commissions and omissions), subsequent mediation analyses focused only on delayed discounting. In addition, neuroticism was not significantly associated with eating restraint (b = 0.111; $t(40) = 1.754$; $p = 0.088$) (*figure 2)*, and therefore no mediation analyses were conducted with regard to this domain of disordered eating. The results of the mediation model examining neuroticism, delayed discounting assessed via AUC, and disordered eating. Gender was associated with engagement in disordered eating, and was included as a covariate in all direct effect analyses.

Eating Concern

Neuroticism was negatively associated with the delay discounting AUC [$b = -0.033$, $t(40) = -2.445$, $p = 0.019$], and delay discounting was significantly associated with eating concern [$b = -2.945$, $t(40) = -2.730$, $p = 0.010$] . The total effect of neuroticism on eating concern was significant [$b = 0.213$, $t(40) = 2.080$, $p = 0.044$], but the direct effect, which controls for delay discounting, was not significant [$b = 0.119$, $t(40) = 1.101$, $p = 0.278$; Model $R^2 = 0.449$, $F_{(3, 40)} = 2.951$, $p = 0.046$]. The absolute value of the unstandardized coefficient and of the path was reduced and became non-significant. This suggests that delay discounting fully mediates the relationship between neuroticism and eating concern (*Figure 3)*.

Shape Concern

Neuroticism was negatively associated with the delay discounting AUC [b = -0.033, t(40) = -2.445, p = 0.019], and delay discounting was significantly associated with shape concern [b = -2.445, t(40) = -2.778, p = 0.008] . The total effect of neuroticism on shape concern was significant [b = 334, t(40) = 4.871, p < 0.001], and the direct effect, which controls for delay discounting, was also significant [b = 0.292, t(40) = 3.904, p < 0.001; Model R^2 = 0.541, $F_{(3, 40)}$ = 13.762, p < 0.001]. However, the absolute value of the unstandardized coefficient of the path was reduced. Sobel's test was of mediation showed that this reduction was statistically significant, Z = -2.02, p = 0.04. This suggests that delay discounting partially mediates the relationship between neuroticism and shape concern (*Figure 4)*.

Weight Concern

Neuroticism was negatively associated with the delay discounting AUC [b = -0.033, t(40) = -2.445, p = 0.019], and delay discounting was significantly associated with weight concern [b = -2.372, t(40) = -3.176, p = 0.003] . The total effect of neuroticism on weight concern was significant [b = 0.286, t(40) = 3.804, p = 0.001], but the direct effect, which controls for delay discounting, was reduced in significance [b = 0.227, t(40) = 2.890, p = 0.007; Model R^2 = 0.472, $F_{(3, 40)}$ = 10.444, p < 0.001]. The absolute value of the unstandardized of the path was reduced, and although decreased in significance was still significant. This suggests that delay discounting partially mediates the relationship between neuroticism and weight concern (*Figure 5)*.

Global Disordered Eating

Neuroticism was negatively associated with the delay discounting AUC [b = -0.033, t(40) = -2.445, p = 0.019], and delay discounting was significantly associated with global disordered eating [b = -2.453, t(40) = -3.422, p = 0.002] . The total effect of neuroticism on global disordered eating was significant [b = 0.236, t(40) = 3.688, p = 0.001], but the direct effect, which controls for delay discounting, was reduced in significance [b = 0.173, t(40) = 2.589, p = 0.014; Model R^2 = 0.436, $F_{(3, 40)}$ = 9.005, p < 0.001]. The absolute value of the unstandardized of the path was reduced, and although decreased in significance was still significant. This suggests that delay discounting partially mediates the relationship between neuroticism and global disordered eating (*Figure 6)*.

CHAPTER IV

DISCUSSION

The present study investigated the role of neuroticism and impulsivity in predicting engagement in disordered eating in adolescents and emerging adults. Research is mixed in its understanding of neuroticism as an associated risk factor for disordered eating. In addition, previous research has lacked examination of both neuroticism and impulsivity in the manifestation and maintenance of disordered eating, as well as examining impulsivity as a mediator between neuroticism and disordered eating. Additionally, an expansion to include research on adolescent and emerging adults, especially those that have not been diagnosed with an eating disorder, but may be engaging in disordered eating, has been extremely limited. Findings revealed that among adolescents and emerging adults, neurotic groups were significantly different with regard to disordered eating patterns and delayed discounting. Additionally, delay discounting mediated the relationship between neuroticism and engagement in disordered eating.

High neurotic adolescents and emerging adults were significantly different than low neurotic and moderate neurotic individual when examining eating concern. Suggesting that highly neurotic adolescents and emerging adults are more likely than low and moderate neurotic adolescents and emerging adults to have a preoccupation with food, fear or losing control over eating, a tendency to eat in secret, not partake in social eating and guilt about eating. This pattern was consented with regard to weight concern as well, indicating that high neurotic adolescent and emerging adults were more likely than low and moderate emerging adults to fixate on the importance of weight, have a negative reaction to prescribed weighing, a preoccupation with their

shape/weight, be dissatisfied with their weight, and have a desire to lose weight. However, with regard to shape concern both high and moderate neurotic adolescents and emerging adults were more likely to want a flat stomach, be preoccupied with the importance of their shape, fear weight gain, be dissatisfied with their shape, experience discomfort when seeing body, avoiding exposure of their shape, and feel fat than low neurotic adolescents and emerging adults. This was also found when comparing high neurotic and moderate neurotic adolescents and emerging adults. Overall, this revealed that highly neurotic adolescents and emerging adults are more likely to engage in overall patterns of disordered eating compared to moderate and low neurotic adolescents and emerging adults. These findings are expected. Since highly neurotic individuals, are often characterized by their high anxiety, excessive worrying and perfectionism, it is likely that they are concerned with how they appear to others. This is consistent with finding differences among groups only within each "concern" domain (i.e., eating concern, shape concern and weight concern), suggesting that highly neurotic adolescents and emerging adults appear to worry (or be concerned) about their weight and body shape and have a desire to appear "ideal." As a result, they engage in disordered eating behavior, specifically behavior that involves being vigilant about how they may be physically perceived by others, which contributes to their anxiety.

Eating restraint did not differ by groups -- suggesting that neuroticism was not related to how an adolescent or emerging adult exhibited restraint over eating, avoided eating or food, had strict dietary rules, or often functioned on an empty stomach. This finding may be due to the link between restraint and striving for perfectionism that cannot be explained by this higher-order trait of personality, and indicates that neuroticism may be linked to a preoccupation with food,

weight, and shape but may not relate in manifestation of maladaptive eating behaviors. This is again consistent with what would be expected, given that neurotic adolescents and emerging adults seem more aware with how they appear rather than specific engaging in unhealthy eating habits which have no effect on how they are perceived, or which may negatively impact how they are perceived. For example, functioning on an empty stomach cannot be perceived or avoiding food is easily perceived but can be interpreted negatively by others. Thus they may likely be preoccupied with appearance but not engaging in behaviors that would change their appearance or they may be attempting to achieve or maintain their desired appearance via behaviors other than through eating restraint, which have more positive perceptions (e.g. exercise).

Highly neurotic adolescents and emerging adults were also found to discount a delayed monetary commodity more than their low neurotic counterparts. Thus, highly neurotic adolescents and emerging adults are more likely to prefer a smaller, immediate amount of money versus a larger, delayed money than low neurotic adolescents and emerging adults. Neurotic persons are often anxious, moody, and worried. It is believed that the strong emotional reactivity displayed by these individuals may interfere with their executive functioning processes (Hirsh, Morisano, & Peterson, 2008). Therefore it may disrupt the ability to properly consider the benefits of a delayed reward. Further they may accept smaller, immediate rewards (such as receiving $2 now) as a means to cope with their anxiousness instead of waiting for a delayed reward (such as $10 in 5 days). In contrast, low and moderate neurotic adolescents and emerging adults are able to consider the benefits of a delayed reward and are therefore likely to opt for the delayed but larger reward.

This disruption in executive functioning also explains why no differences were found among groups for disinhibition and inattention. Given that neurotic individuals have a tendency to strive for perfectionism on tasks for inhibitory control and attention, they may be more effortful and engaged in behavioral tasks, which one would assume would contribute to better performance compared to low and moderate neurotic individuals. However, the disruption in executive functioning may undermine their performance goals, thereby resulting in similar or worse performance outcomes compared to the other groups, which was observed.

The separate contributions of neuroticism on disordered eating have been discussed. However, the mediation model of whether impulsivity mediates the relationship between neuroticism and engagement in disordered eating has not been examined. Thus this is the first study to date to determine whether impulsivity mediates the relationship between neuroticism and engagement in disordered eating. In the current study, delay discounting was found to fully mediate the relationship between neuroticism and eating concern, meaning that delay discounting entirely explained the relationship between neuroticism and eating concern. Delay discounting partially mediated the relationship between neuroticism and shape concern, neuroticism and weight concern, and neuroticism and global disordered eating. Partial mediation refers to the case in which the path from the independent variable (i.e., neuroticism) and the dependent variable (i.e., shape concern, weight concern, global) is reduced in absolute size but is still different from zero when the mediator is introduced (Hamilton et al., 2013). The full and partial mediation by delay discounting of the effect of neuroticism on engagement in disordered eating demonstrates the

importance of delay discounting in understanding the manifestation of disordered eating among adolescents and emerging adults.

However, delay discounting is not the only factor and did not account for all the variance for the effects of neuroticism on engagement in disordered eating. Significant direct effects of neuroticism on engagement in disordered eating indicates the importance of neuroticism itself as a construct impacting engagement in disordered eating, even without delay discounting. Direct and indirect pathways of a neurotic personality on the engagement in disordered eating reveal different pathways of the effects. Emotional reactivity related to a neurotic personality may have effects on neuro-behaivoral functioning. Neuroticism may alter and disrupt executive functioning processes, thereby increasing vulnerability to engagement in disordered eating, especially via a depressed mood or as a coping mechanism to decrease anxiousness.

Limitations

The present study had several limitations. First data collection was restricted to self-report data. As a result, respondents may under-report behaviors that are viewed as undesirable to society, such as neurotic characteristics and disordered eating patterns. Further, although a complex model of factors is involved in adolescents and emerging adult vulnerability to engagement in disordered eating the present study focused on demonstrating an association between only neuroticism and impulsivity with regard to disordered eating. The study was also cross-sectional and therefore cannot prove causality and is not be the most ideal for mediation analysis. Thus the present study only tested a simple mediation model. Also due to a small sample size, there was not enough power to conduct separate analyses by gender. Finally, participants in the present

study were not representative of all adolescents and emerging adults. The sample was limited in ethnic diversity, younger adolescent ages (13-16 years), and included adolescents and emerging adults that were in school. Since female college students appear to be engaging in disordered eating at higher rates, an examination of adolescents and emerging adults not engaged in post-secondary school is also needed. In addition a more complex model of risk factors over multiple time points (i.e., as adolescence transition into emerging adulthood) and larger sample size encompassing a diverse population of various ethnic groups, ages, and gender is needed.

Conclusions

The goal of the present study was to help better understand the relationship between neuroticism, impulsivity and engagement in disordered eating in the hopes of advancing prevention and treatment programs for eating disorders. High levels of neuroticism were significantly associated with disordered eating, indicating that having a neurotic personality renders adolescents more susceptible to developing various patterns of skewed perceptions of eating, weight, and shape concerns. However, neuroticism was not related to eating restriction, indicating a preoccupation with appearance but not necessarily manifestation of certain forms of maladaptive eating behavior that may have negative perceptions. The present analysis supported previous findings that highly neurotic individuals prefer short-term gains over long-term rewards. On several of the eating disorder domain subtypes, delay discounting fully or partially mediated the relationship between neuroticism and patterns of disordered eating. Results indicate that neuroticism and impulsivity, specifically delay discounting, may play an important role in adolescent and emerging adult engagement in disordered eating. Our understanding of mechanisms that underlie disordered eating during this developmental period would benefit

greatly from increased research on the role of personality traits and delay discounting. This research will enhance education -, prevention- and intervention programs.

Future research should aim to understand specifically which eating disorders are targeted by high levels of neuroticism and impulsivity. Additionally, studies should provide further information on how impulsivity mediates certain facets of disordered eating over others. This information may provide insight into previously unstudied facets of eating disorders and contribute to future prevention and intervention programs targeting at risk adolescent populations in the hopes of decreasing the occurrence of disordered eating patterns and eating.

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Table 1

Participant Demographics

		Euro-American	Hispanic	Asian-American	Mixed Race	Total
Males	N	12	3	0	0	15
	% of group	40	37.5	0	0	100
	% out of total	30	7.5	0	0	37.5
Females	N	18	5	1	1	25
	% of group	60	62.5	100	100	100
	% out of total	45	12.5	2.5	2.5	62.5

Table 2

ANOVA: Neuroticism and Disordered Eating

Behavior	**F-Value (P-value)**
Eating Concern	3.737 (0.033)
Shape Concern	15.247 (0.000)
Weight Concern	9.723 (0.000)
Overall	9.345 (0.001)
BMI	2.184 (0.217)
Eating Restraint	2.045 (0.144)

Table 3

ANOVA: Neuroticism and Impulsivity

Behavior	**F-Value (P-value)**
DDQ	3.254 (0.022)
Go/Stop	0.266 (0.769)
CPT Commissions	1.580 (0.220)
CPT Omissions	0.279 (0.758)

Figure 1

Mediating role of impulsivity in the association between neuroticism and disordered eating

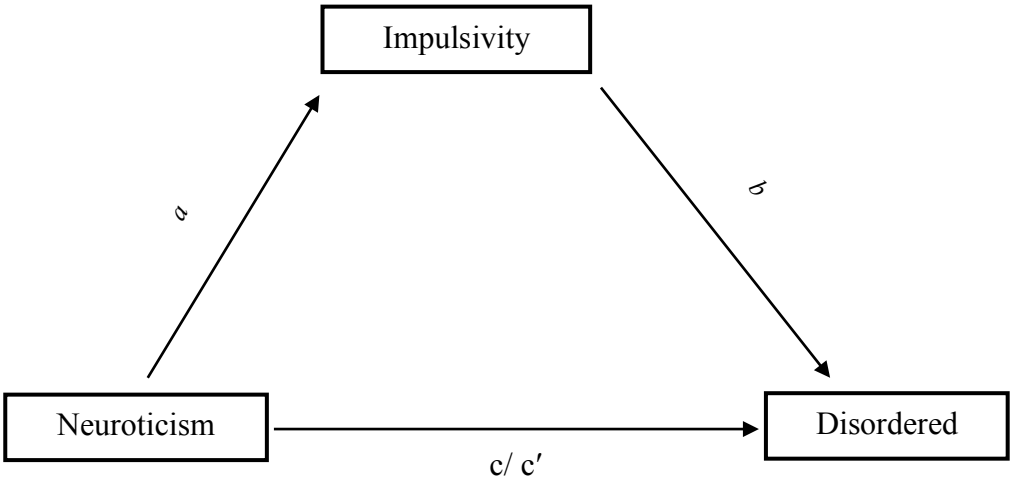

Figure 2

Eating Restraint

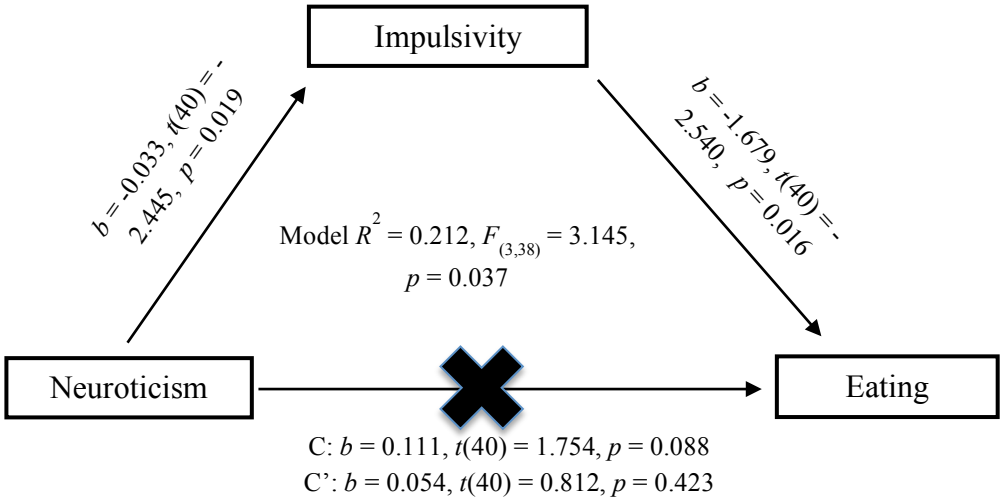

Figure 3

Eating Concern

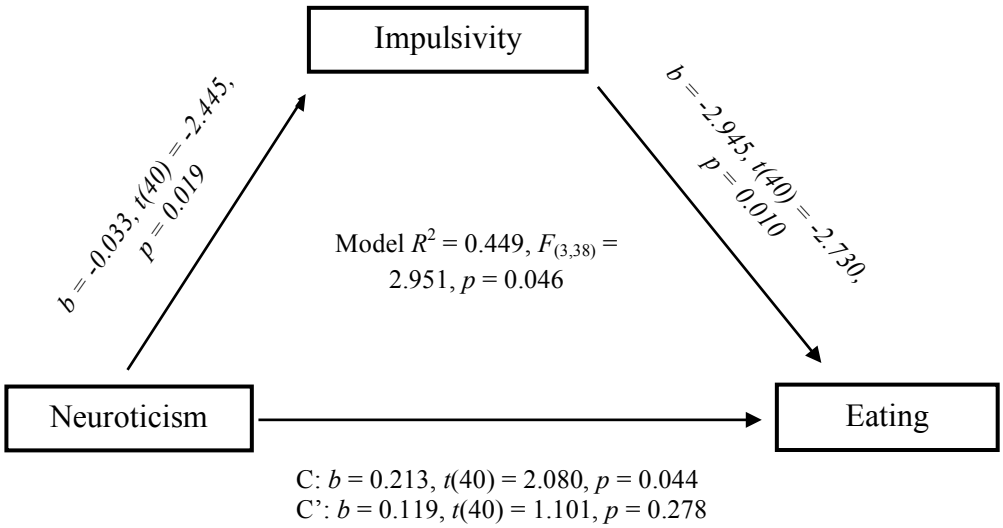

Figure 4

Shape Concern

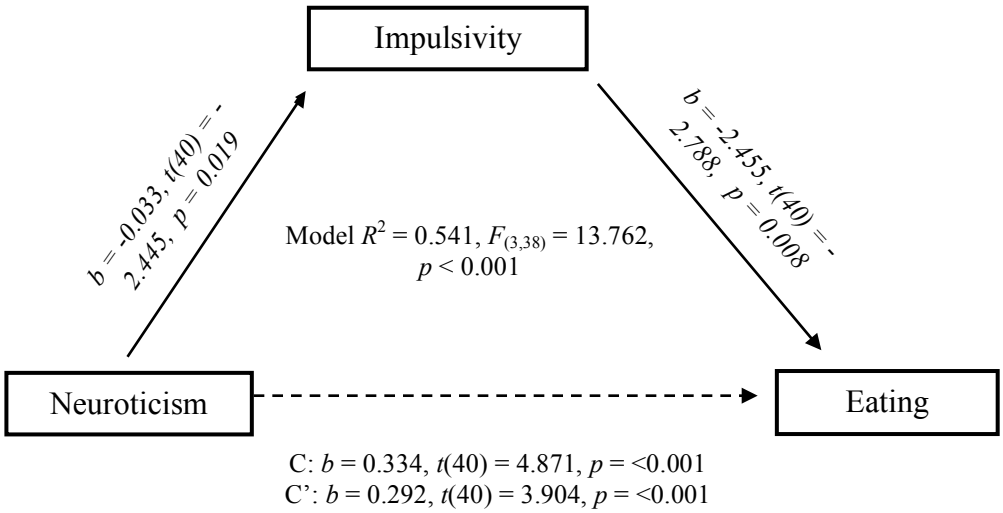

Figure 5

Weight Concern

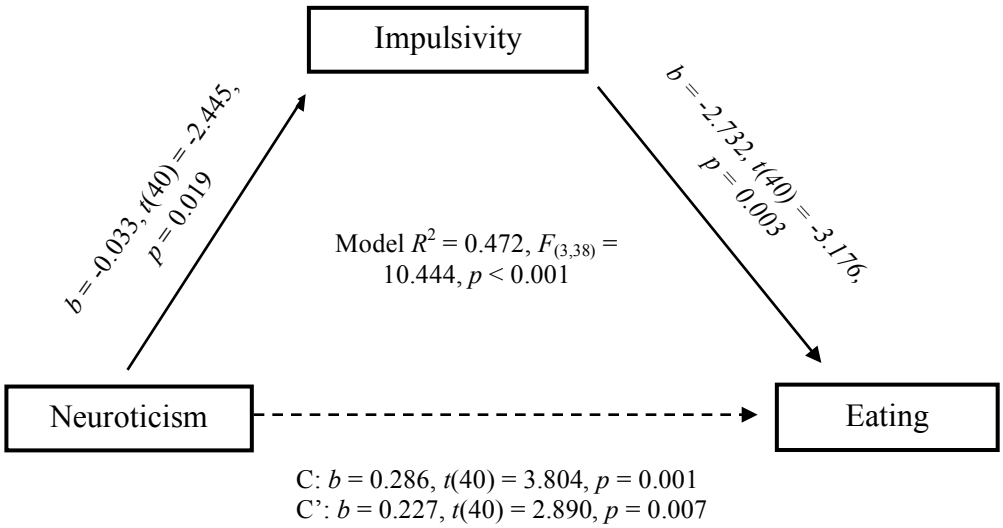

Figure 6

Overall Global Scale